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AKTIVITAS *SUN PROTECTION FACTOR* EKSTRAK DAUN *Bambusa* spp. DAN PREDIKSI SEBAGAI ANTIHIPERPIGMENTASI SECARA *IN SILICO*

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INTISARI

Indonesia sebagai negara tropis menerima paparan sinar ultraviolet (UV) yang relatif tinggi sepanjang tahun. Paparan sinar UV yang berlebihan dapat menyebabkan berbagai gangguan kulit, *sunburn*, *photoaging*, hiperpigmentasi, hingga kanker kulit. Daun bambu (*Bambusa* spp.) diketahui mengandung berbagai senyawa bioaktif, terutama golongan fenolik dan flavonoid, yang berpotensi berperan sebagai fotoprotektor sekaligus agen antihiperpigmentasi. Oleh karena itu, penelitian ini bertujuan untuk mengetahui aktivitas *Sun Protection Factor* (SPF), kandungan total fenolik, serta memprediksi potensi antihiperpigmentasi ekstrak daun *Bambusa oldhamii*, *Bambusa balcooa*, dan *Bambusa vulgaris* var. *vittata* melalui pendekatan *in silico*. Daun bambu diekstraksi menggunakan etanol 70 % dan difraksinasi dengan metode ekstraksi cair-cair menggunakan pelarut n-heksana, etil asetat, dan etanol-akuades. Aktivitas SPF ditentukan secara spektrofotometri UV-Vis, sedangkan kandungan total fenolik dianalisis menggunakan metode Folin-Ciocalteu. Senyawa pada ekstrak terbaik diidentifikasi menggunakan LC-HRMS dan dilanjutkan dengan molecular docking terhadap enzim tirosinase (PDB ID: 5M8O).Hasil penelitian menunjukkan bahwa ekstrak dan fraksi daun *Bambusa* spp. memiliki aktivitas SPF kategori proteksi sedang hingga maksimal. Nilai SPF tertinggi diperoleh pada ekstrak kasar *Bambusa oldhamii* sebesar 39,30 ± 0,29, sedangkan kandungan total fenolik tertinggi diperoleh pada fraksi semipolar *Bambusa oldhamii* sebesar 18,98 ± 0,98 mg GAE/g. Analisis LC-HRMS mengidentifikasi beberapa senyawa yang berpotensi sebagai antihiperpigmentasi, yaitu *L-Phenylalanine, D-Pantothenic acid, coumarin, 2-Coumaroylquinic acid, Ethyl p-Coumarate, apigenin, 3,5-Dimethoxy-4-hydroxybenzaldehyde, luteolin,* dan *kaempferol*. Hasil molecular docking menunjukkan bahwa seluruh senyawa tersebut memiliki afinitas pengikatan yang lebih baik dibandingkan *tropolone,* dengan *luteolin* menunjukkan nilai binding affinity terbaik sebesar -9,3 kcal/mol. Berdasarkan hasil penelitian, ekstrak daun *Bambusa oldhamii* berpotensi dikembangkan sebagai sumber bahan alam untuk aplikasi fotoprotektif dan antihiperpigmentasi melalui mekanisme penghambatan enzim tirosinase.

Kata Kunci: aktivitas SPF, antihiperpigmentasi, *Bambusa* spp., LC-HRMS, tirosinase, total fenolik, *molecular docking*.

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SUN PROTECTION FACTOR ACTIVITY OF *Bambusa* spp. LEAF EXTRACT AND PREDICTION AS ANTIHYPERPIGMENTATION IN SILICO

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ABSTRACT

Indonesia, as a tropical country, experiences high levels of ultraviolet (UV) radiation throughout the year. Excessive exposure to UV radiation can induce various skin disorders, such as sunburn, photoaging, hyperpigmentation, and skin cancer. Bamboo leaves (*Bambusa* spp.) have been reported to contain various bioactive compounds, particularly phenolic and flavonoid constituents, which may contribute to photoprotective and antihyperpigmentation activities. Therefore, this study aimed to evaluate the Sun Protection Factor (SPF) activity, total phenolic content (TPC), and predict the antihyperpigmentation potential of bamboo leaf extracts through an *in silico* molecular docking approach. Leaves of *Bambusa oldhamii*, *Bambusa balcooa*, and *Bambusa vulgaris* var. *vittata* were extracted using 70 % ethanol and subsequently fractionated by liquid-liquid extraction employing nonpolar (n-hexane), semipolar (ethyl acetate), and polar (ethanol-water) solvents. SPF values were determined using UV-Vis spectrophotometry, while total phenolic content was analyzed using the Folin-Ciocalteu method. Bioactive compounds from the most active extract were identified using LC-HRMS and further evaluated through molecular docking against tyrosinase (PDB ID: 5M8O). The results demonstrated that the extracts and fractions of *Bambusa* spp. exhibited SPF activity within the moderate to maximum-protection category. The highest SPF value was observed in the crude extract of *B. oldhamii* (39.30 ± 0.29), whereas the highest total phenolic content was found in the semipolar fraction of *B. oldhamii* (18.98 ± 0.98 mg GAE/g). LC-HRMS analysis identified several compounds with potential anti-hyperpigmentation activity, including L-phenylalanine, D-pantothenic acid, coumarin, 2-coumaroylquinic acid, ethyl *p*-coumarate, apigenin, 3,5-dimethoxy-4-hydroxybenzaldehyde, luteolin, and kaempferol. Molecular docking results revealed that all identified compounds exhibited stronger binding affinities than tropolone, with luteolin showing the most favorable binding affinity (-9.3 kcal/mol). In conclusion, *B. oldhamii* leaf extract possesses promising photoprotective and antihyperpigmentation potential. The identified phenolic and flavonoid compounds, particularly luteolin, are predicted to contribute significantly to tyrosinase inhibition and may serve as prospective natural agents for skin photoprotection and hyperpigmentation inhibition.

Key Words: antihyperpigmentation, *Bambusa* spp., LC-HRMS, molecular docking, SPF activity, total phenolic content, tyrosinase